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ture of clay and gravel. Directly underneath the stratum of the original surface soil which contained the seeds was a very thin layer of clay, below which was the bed of gravel and sand.

These seeds were not buried sufficiently deep to prevent them from being frozen, but the layer of clay above served quite well to protect them from the air, thus diminishing the respiratory activity, and the gravel and sand beneath furnished the best possible conditions of drainage. Under such favorable conditions the vitality of many seeds might be preserved, when buried in the soil, for a score of years or more.—J. W. T. DUVEL, *U. S. Department of Agriculture, Washington, D. C.*

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#### CUMAPHYTISM IN ALARIA.

(WITH TWO FIGURES)

AMONG the species of *Alaria* displayed upon the kelp beds of the Minnesota Seaside Station, the one named *Alaria nana* by Mr. H. F. Schrader<sup>2</sup> has been found to show a somewhat remarkable adaptation to the surf habitat which it shares with *Postelsia palmaeformis* Rupr. along the Straits of Fuca. Plants of *Alaria nana* are found intermingled with *Postelsia* and form for the most part an undergrowth between the trunks of the larger kelp. Upon few rocks have there been found unmixed growths of *Alaria*. Last summer, however, I was enabled to examine two or three beds of *Alaria nana* which had not come under the observation of Mr. Schrader. A series of plants was collected for the laboratory work in the University of Minnesota, and two of them have been photographed to accompany these notes. Their consideration will make it apparent how strongly the *Alaria* type may become adapted to existence in the surf.

When growing intermixed with *Postelsia* the common form of *Alaria nana* is as shown in fig. 1. The plants will not average more than 20<sup>em</sup> in length. In these plants the mid-lamina is well developed, and the gonidiophylls are comparatively slender and their entire surface, with the exception of a narrow marginal region, is soral. Toward the base of a *Postelsia* formation the plants of *Alaria nana* average somewhat larger, and the stipes are not erect, but decline upon the rocks. Higher in the formation the size of the plants diminishes and the stipes become more erect, until well toward the top the erect habit

<sup>2</sup>SCHRADER: Observations on *Alaria nana*, sp. nov. Minn. Bot. Studies 3: 157. 1903.

is the rule. At the same time the stipes become more massive and the gonidiophylls become broader.

Along the top of the formation, at two or three localities, decidedly unusual plants of *Alaria nana* have been observed. Sometimes hundreds of these are found growing together. *Fig. 2* shows such a plant placed upon the right of and beside an individual of *Postelsia palmae-formis* which is introduced for comparison. The plant shown in *fig. 2* is but 10<sup>cm</sup> in height, nor do plants of this form ordinarily measure much more than this. The general resemblance in habit to *Postelsia*

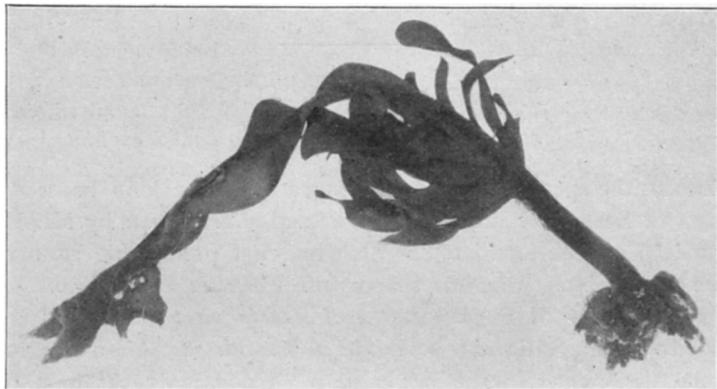


FIG. 1.—Plant of *Alaria nana* H. F. Schrader; natural size about 20<sup>cm</sup> in length. After photograph by C. J. Hibbard.

is certainly very marked. The mid-lamina is in all such plants eroded to the base or but poorly developed. Under such conditions it is evident that the gonidiophylls must assume the photosynthetic function, and they have consequently taken a broader form. One of these obovate gonidiophylls is clearly shown in the figure. Upon many of these gonidiophylls soral areas are either not developed or limited to the basal portion. The number, too, of the gonidiophylls seems to be increased as compared with normal plants of the lower levels. The stipe is quite erect, very firm, and provided with a strong growth of hapteres at the base. In general, the plant which has come to live under the conditions to which *Postelsia* has adapted itself receives the imprint of environmental forces, as did the ancestral forms of the other kelp, and exhibits a striking homoplasy.

In comparing the plants shown in *fig. 2*, it should be remembered that *Postelsia*, a member of the *Lessonia* group, is essentially unilami-

nate, and the laminae displayed at the summit of the stipe have arisen by repeated longitudinal splitting of the original single lamina. *Alaria*, on the other hand, maintains its original mid-lamina without splitting, and this would be found at the center of the tuft, while the conspicuous laminae are the modified and hypertrophic gonidiophylls.



FIG. 2.—Plants of *Postelsia palmaeformis* Rupr. (on the left) and *Alaria nana* H. F. Schrader (on the right). Extreme cumaphytic form. After photograph by C. J. Hibbard.

Yet, while developed in this different manner, the ultimate result is, in each case, a tuft of leaves at the end of a short, thick, and firmly attached stipe.

The series of plants as displayed upon the rocks is certainly very instructive and to be fully appreciated must be studied in the field. In this note I have attempted merely to indicate the extreme form which an *Alaria* may assume in the cumaphytic habitat.—CONWAY MACMILLAN, *University of Minnesota*.